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Territorial Distribution of Kazakhstan's Knowledge-Intensive Sectors of the Economy: Opportunities and Prospects

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Abstract

The key strategic priorities of the development of Kazakhstan are diversification, technological modernization and formation of a new industrial structure. It is clear that modern industrial structure is impossible to be formed without knowledge-based industries and fields, and prerequisites for their development in the regions of Kazakhstan differ significantly. The goal of this article is to assess the prerequisites and prospects of spatial development of knowledge-based sectors of Kazakhstan's economy. The methodology of the article is based on the theoretical and methodological provision that possibilities for the development of knowledge-based economy in local territories and at certain points depend of specific factors such as availability of research and academic organizations in the territory. System-structural and functional approaches, methods of empirical research, including observation, comparison, generalization, systematization, methods of analysis and synthesis, logical analysis, methods of regional studies, and cluster analysis were used. There was used as the information base of the research the data reflected in the periodical press, the data of ministries, works of scientists of Kazakhstan and copyright developments under the framework of the study of innovation localization process and knowledge-based sectors of the economy. It is shown that development of knowledge-based sectors of economy in Kazakhstan will not be widespread, but will have a «cellular nature», located inside the boundaries of separate territories or «high-tech districts» (knowledge-based hubs, knowledge-based clusters, and smart cities) and perspectives of their development will be considered. The results of the research have been tested while recommendations development on issues of Kazakhstan territories' technological modernization.

Keywords: Economics, Strategy, Knowledge-based Economy, Spatial Development, High-Tech District, Cluster, Technopark, smart city, Kazakhstan.

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Қазақстан экономикасының ғылымды қажетсінетін секторларын аумақтық орналастыру: мүмкіндіктері мен перспективалары

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Түйін

Әртараптандыру, технологиялық жаңғырту және жаңа өнеркәсіптік құрылымды қалыптастыру Қазақстан дамуының маңызды стратегиялық басымдықтары болып табылады. Қазіргі заманғы өнеркәсіптік құрылымды ғылыми сыйымды өндірістер мен салаларсыз қалыптастыру мүмкін болмайтыны анық, ал олардың Қазақстан өңірлерінде дамуының алғышарттары айтарлықтай ерекшеленеді. Мақаланың мақсаты – Қазақстан экономикасының ғылыми сыйымды секторларын кеңістікте дамыту алғышарттары мен перспективаларын бағалау. Мақаланың әдіснамасы жергілікті аумақтарда және белгілі бір жерлерде ғылыми сыйымды экономиканы дамыту мүмкіндіктері ғылыми сыйымды секторлар үшін ғылыми және білім беру құрылымдарының аумақта бар болуы сияқты ерекше факторларға байланысты екендігі туралы теориялық-әдіснамалық ережеге негізделген. Бақылау, салыстыру, жалпылау, жүйелеу, талдау және синтез әдістері, логикалық талдау, аймақтық зерттеулер мен кластерлік талдау әдістерін қоса алғанда, жүйелік-құрылымдық және функционалдық тәсілдер, эмпирикалық зерттеу әдістері қолданылған. Зерттеудің ақпараттық базасына мерзімді баспасөзде көрсетілген деректер, министрліктердің деректері, қазақстандық ғалымдардың жұмыстары, сондай-ақ экономиканың инновациялық және ғылыми сыйымды секторларын оқшаулау процестерін зерттеу шеңберіндегі авторлық атқарымдар жатады. Қазақстан экономикасының ғылыми сыйымды секторларын дамыту жаппай емес, жекелеген аумақтар немесе «хайтек-дистриктілер» (ғылыми сыйымды хабтар, ғылыми сыйымды кластерлер, және ақылды қалалар) шеңберінде оқшаулана отырып, «ошақтық» сипатқа ие болатыны және олардың даму перспективалары қаралатыны көрсетілді. Зерттеу нәтижелері Қазақстан аумағын технологиялық жаңғырту мәселелері бойынша ұсынымдар әзірлеу барысында апробацияланды.

Түйін сөздер: экономика, стратегия, ғылыми сыйымды экономика, кеңістікті дамыту, хайтек-дистрикт, кластер, технопарк, смарт-сити, Қазақстан.

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Территориальное размещение наукоемких секторов экономики Казахстана: возможности и перспективы

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Аннотация

Ключевыми стратегическими приоритетами развития Казахстана выступают диверсификация, технологическая модернизация и формирование новой промышленной структуры. Очевидно, что современная промышленная структура не может быть сформирована без наукоемких производств и отраслей, а предпосылки их развития в регионах Казахстана существенно отличаются. Цель статьи – оценить предпосылки и перспективы пространственного развития наукоемких секторов экономики Казахстана. В основу методологии статьи взято теоретико-методологическое положение о том, что возможности развития наукоемкой экономики на локальных территориях и определенных точках зависят от специфических факторов, таких как наличие на территории научных и образовательных структур. Использованы системно-структурный и функциональный подходы, методы эмпирического исследования, включая наблюдение, сравнение, обобщение, систематизация, методы анализа и синтеза, логический анализ, методы региональных исследований и кластерного анализа. Информационной базой исследования послужили данные, отраженные в периодической печати, данные министерств, работы казахстанских ученых, а также авторские наработки в рамках исследования процессов локализации инновационных и наукоемких секторов экономики. Показано, что развитие наукоемких секторов экономики Казахстана будет носить не повсеместный, а «очаговый» характер, локализуясь в рамках отдельных территорий или «хайтек-дистриктов» (наукоемкие хабы, наукоемкие кластерыт и смарт-города), и рассмотрены перспективы их развития. Результаты исследования были апробированы в ходе разработки рекомендаций по вопросам технологической модернизации территорий Казахстана.

Ключевые слова: экономика, стратегия, наукоемкая экономика, пространственное развитие, хайтек-дистрикт, кластер, технопарк, смарт-сити, Казахстан

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Introduction

Spatial distribution of knowledge-based economy and its separate sectors is an actively developing direction of research both in foreign and Kazakhstani science [1-9]. Obviously, as with any other type of economic activity spatial distribution of a knowledge-based economy is on the whole built on general principles of territorial spatial location affected by various factors (raw materials, demand, infrastructure, labor, etc.). Therewith, it is expected that possibility of the development of knowledge-based economy in local territories and areas depend on specific factors [10].

Major importance among these factors has the presence of educational and scientific structures in the territory, presenting leading channels of technology and new knowledge, and suppliers of highly qualified personnel for knowledge-based sectors of the economy [11, 12]. Whereby it should be considered that a knowledge-based economy includes different sectors and directions: high-tech industries, knowledge-based services, and digital development. These are heterogeneous types of activity producing different goods in different ways. In the high-tech sector material goods are produced mostly, in the service sector non-material products, and in the digital sector- virtual products.

Accordingly, different degree of dependency on traditional distribution factors is characteristic of these sectors. For example, through the distribution of high-tech manufacturing the influence of raw materials, energy, and transport factors can be seen, although to a lesser extent than that there has been in the medium-tech sector. At the same time for the development and distribution of knowledge-based services availability of corresponding physical infrastructure doesn't matter as much. The purpose of the current research is to assess the prerequisites and prospects of the spatial development of knowledge-based sectors of the economy in Kazakhstan. The research hypothesis lies in the fact that when making decisions on the development and distribution of knowledge-based industry and economic sectors it is necessary to take into account prerequisites peculiar to the territories to a different extent.

Literature review

Studies of the advantages of specialization and the geographical localization of economic activity have been in the field of economic science for a long time. A. Smith [13] noted that specialization, along with the division of labor, is the main factor in productivity growth. A. Marshall [14] singled out such advantages of industrial localization as the concentration of qualified specialists and employers, the specialization of suppliers, and the rapid dissemination of knowledge and ideas. He believed that skills accumulation, know-how and knowledge take place in a spatially limited context, where a favorable "industrial atmosphere" is created that can enhance economic growth and stimulate the production and distribution of innovations.

P. Krugman [15, 16] noted that production tends to be concentrated in individual countries, regions, or cities. Concentration is defined in relation to the type of economic activity, sector, subsector, industrial group, etc., and means the degree of concentration or sparseness of industrial production within a particular area.

The ideas of localization were developed in the works of M. Porter, who defined a group of geographically adjacent interconnected companies and organizations characterized by common activities and complementary to each other in a certain sector of the economy as clusters [17]. Numerous publications of the latest decades confirmed the fact that space-specific factors strongly influence the innovative activity of firms and regional features of technological specialization [18-21].

Developed market and institutional environment largely contributes to the formation of knowledge-based sectors, as well as high academic and technological potential which are available in a limited number of territories

Foremost, major cities refer to such territories. There are concentrated scientific centers, universities, big companies, significant intellectual potential, and a developed financial, business, and information infrastructure. Whereas in the industrial age major cities acted as industrial centers, while in knowledge-based economy their creative direction is strengthened, and conditions for creativity are accumulated as the foundation for the emergence of new scientific ideas, inventions, and a creative approach. Moreover, the cultural aspect as an integral element of creativity together with conditions for innovation is as much important as scientific and educational potential, investment opportunities and infrastructure provision. Accordingly, considering factors facilitating the emergence development of innovations in cities, it is important to take into account the existence of cultural prerequisites.

Such an approach is in particular monitored among the compilers of the global index of innovative cities[1]. Their assessment is based on 162 indicators, characterizing diverse cultural assets (62 indicators), the level of infrastructure development (77 indicators), involvement in the global network and global reach (23 indicators). The composition

[1] Innovation Cities Index 2021: Global. Innovation Cities Program; 2021 [updated 13 January2021; quoted 13 January2021]. Available at: https://www.innovation-cities.com/worlds-most-innovative-cities-2021-top-100/25477/

of cultural assets also considers the architectural look of the city, the state of the air environment, the level of greenspace expansion, availability of theatres and museums, sport facilities, tolerance level etc. Indicators describing infrastructure development include a wide spectrum of the index of evolution development of transport, financial, business, economic, scientific, educational, innovative, information, industrial, and social infrastructure. Another group of indicators, the smallest one, form indicators describing economic power, the strategical status of the city, involvement in global investment, trade, and transport flow.

It suggests that despite the importance of the scientific, educational, technological potentials it is not enough for the formation and development of knowledge-based economy. Another set of conditions is needed as well, which is reflected in the earlier mentioned list of indicators of innovative cities ranking. Hence development and distribution of knowledge-based economy, apparently will not repeat previous models of new industries emergence specific to a traditional, industrial economy.

It indicates, for example, the experience of initiation and progression of industries based on nanotechnology in the USA. This economic sector is in its initial phase of the technology lifecycle. in the course of the active process of research and innovation potential creation. It goes in the form of the formation of the so-called "nano-districts" - centers of territorial concentration of research and development in the field of nanotechnology [22]. In total there are 30 centers, which differ according to scale, organizational characteristics, and specialization.

"Nano-districts" have models of formation - either through linking to regions, where other high-tech clusters operate or by "spinning off" to new regions with low potential for high-tech industries. Notably, there can be no large knowledge bases in new territories. The existence of one leading scientific-educational organization is enough on the basis of which the region, insignificant with regard to high technologies, can be formed as a major center.

A special area for the development of a knowledge-based economy is the formation of "smart cities". The model of a "smart city" expects wide use of information and communication technologies in all areas of the urban economy. Special attention is given to such sectors, which have key meaning for any city, as security, water supply, medical services, transportation, waste management and energy [23].

There are possible two ways of cities development based on the "smart model". The first way – is building "from scratch", which is a reference point for a "smart model" when creating a new city, purposeful construction of an initially "smart city". This model is predominantly implemented in Asia: in the city of Songdo in South Korea, the city of Cyberjaya in Malaysia, and the city of Abu Dhabi in the UAE. Another option is characteristic to most of the countries of Western Europe and Northern America where the "smart model" is implemented through modernization of existing cities infrastructure.

More recently, in spatial economy to characterize the distribution of given economic activity and its concentration in the form of a special kind of node, the concept of "hub" is used. Often they talk about transport hubs, with the development of the digital economy, the concept of innovation hubs has appeared, which is usually understood as technoparks and IT start-up incubators [24]. From our point of view, the notion of hubs with respect to knowledge-based economy can be expanded in terms of content and in terms of local binding. In particular these are major cities, where there are concentrated universities and scientific organizations, technological companies, customers, and providers of new knowledge, interconnected within networks as knowledge-intensive hubs[2].

The literature review showed a great interest in the study of the questions of spatial distribution influenced by numerous factors, especially infrastructural ones. There are emerging new trends on knowledge-based activity distribution, such as the formation of high-tech and nano-districts, the development of "smart cities", and the formation of knowledge-intensive hubs, which should be taken into account when spatially distributing knowledge-based sectors of the economy in Kazakhstan.

Methodology

In the article a combined methodological approach was used to the study of the localization of knowledge-intensive industries: system-structural and functional approaches, methods of empirical research, including observation, comparison, generalization, systematization, methods of analysis and synthesis, and logical analysis. Along with this, the methods of regional studies and cluster analysis were used [17, 25].

To quantify the localization potential of knowledge-intensive industries, localization coefficients were calculated in relation to the types of economic activity classified as medium and high technology industries according to the OECD methodology, as well as knowledge-intensive services. In general, it should be noted that the use of

[2] The role of hubs in the development of innovations. Cisco; 2021 [updated 13 January2021; quoted 13 January2021]. Available at: https://www.cisco.com/c/ru_ru/about/press/press-releases/2014/07-070814a.html

the two approaches showed similar results, which allows us to count on the reliability of the results.

The localization coefficients of knowledge-intensive products were calculated using formula 1.

$$LQ_{ji} = \frac{q_{ji}}{Q_i} \cdot \frac{q_j}{Q}, \quad (1)$$

q_{ji} - the volume of knowledge-intensive products/services j in region i;

q_j - the volume of knowledge-intensive products/services j in the country;

Q_i – the volume of manufacturing products/services in region i;

Q – the volume of manufacturing products/services in the country.

The information base of the study made-up data from ministries, web resources of innovative infrastructure facilities, the results of scientific research in periodicals, as well as the author's results on the study of the processes of localization of innovative and high-tech sectors of the economy in the country.

Results and discussion

Potential high-tech districts

The knowledge-based economy in Kazakhstan is still in the formation stage. A brief analysis of the prerequisites of its development allows to "picture" the geography of the future distribution of knowledge-based sectors. Apparently, they will be associated with already existing in the regions-scientific-innovative and production-technological potential [26]. In this study, we proceeded from the fact that the knowledge-intensive sector of the economy is formed by knowledge-intensive manufacturing industries and knowledge-intensive services. 5 manufacturing industries and 5 service industries were selected. Regions for which the coefficient of localization is 1 or more are considered as having prerequisites for the development of clusters. At the same time, calculations of the localization coefficient give a somewhat contradictory picture (Table 1).

Tab. 1. Localization of knowledge-intensive industries and services

Region	Industry						Services				
	Chemical	Pharmaceutics	Mechanical engineering	Manufacture of computers, electronic and optical equipment	Production of electrical equipment	Manufacture of cars, trailers and semi-trailers	Programming and Broadcasting	Computer	Information	Research and Development	Professional, scientific and technical
Akmola	0,69	0,07	**1,21**	0,00	0,09	0,79	0,19	0,27	0,11	0,73	0,15
Aktobe	**1,92**	0,30	0,64	**3,63**	0,05	0,00	0,19	0,29	0,42	0,22	0,68
Almaty	0,41	**2,94**	0,38	0,33	**3,36**	0,00	0,35	0,14	0,35	0,51	0,46
Atyrau	**2,07**	0,00	0,54	0,00	0,14	0,00	0,06	0,11	0,14	0,35	**1,94**
West-Kazakhstan	0,33	0,00	**1,43**	0,57	**2,25**	0,05	0,11	0,42	0,12	0,20	0,25
Zhambyl	**12,79**	0,00	0,20	0,64	0,00	0,00	0,25	0,24	0,15	0,86	0,15
Karaganda	0,63	0,64	0,44	0,32	0,47	0,00	0,32	0,58	0,80	0,85	0,19
Kostanay	0,28	0,00	**3,23**	0,00	0,06	**7,90**	0,28	0,84	0,13	0,35	0,20
Kyzylorda	**1,95**	0,00	0,65	0,00	0,00	0,00	0,39	0,22	0,07	0,19	0,35
Mangistau	**3,99**	0,09	**1,75**	0,00	0,00	0,00	0,11	0,11	0,27	**1,86**	0,22
Pavlodar	0,77	0,06	0,74	0,04	0,54	0,05	0,24	0,47	0,51	0,24	0,36
North-Kazakhstan	0,34	0,50	**1,73**	**12,70**	0,64	0,03	0,47	0,68	0,31	0,22	0,19
Turkestan	0,03	0,09	0,68	0,00	**6,06**	0,00	0,08	0,06	0,10	0,08	0,03
East-Kazakhstan	0,35	0,10	**1,06**	0,05	0,73	**1,94**	0,15	0,45	0,21	**2,41**	**1,35**
Nur-Sultan City	0,14	0,02	**1,21**	2,10	0,43	0,00	**2,08**	**1,61**	**2,12**	**1,06**	0,69
Almaty City	0,34	**3,13**	**1,68**	**4,53**	**1,91**	**2,31**	**1,44**	**1,67**	**1,25**	**1,54**	**1,44**
Shymkent City	0,38	**8,49**	0,45	0,19	**3,26**	0,00	0,23	0,32	0,64	0,12	0,16

Many studies note that the standard localization coefficients do not take into account the size of the regional economy and the size of the industry on a national scale and can give both underestimated and overestimated values, therefore, in a number of studies, modified localization coefficients are used [27-29]. As an alternative to modifying the localization coefficient, the analysis can be supplemented by additional calculations of the sizes of cluster groups and cluster foci.

The calculation of the standard localization coefficients showed relatively low values, although close to the threshold values for such industrial regions as Karaganda and Pavlodar regions, each of which provides more than 7% of the production of engineering products. Almaty and Nur-Sultan have much lower localization rates for R&D than East Kazakhstan, although they account for 70% of these services.

Obviously, the best perspectives have the former and present capitals of the country. Almaty for a long time was developed as a leading scientific and educational center of the country, in which the main potential of academic and university science was concentrated. With the change of the capital of the country, there is a corresponding shift in research activity. Modern research infrastructure is being developed in Nur-Sultan, where priority is given to the university sector. The advantage of both cities lies in the relative development of specialized business services, local government support for innovative renewal projects, including smart cities, special city institutions (development centers) aimed at innovation

Shymkent city, Karaganda, East Kazakhstan, and Pavlodar regions have sufficient potential for the formation and development of a knowledge-based economy since they have a relatively developed manufacturing sector, characterized by inconsistent interaction with the local research base. Engineering skills and technology transfer from the fundamental of innovation activity in industry. North-Kazakhstan and West-Kazakhstan regions also have a certain potential for the formation of a knowledge-based economy, because they have retained the competencies necessary for the manufacturing sector.

In Mangistau, Atyrau, Aktobe and Kyzylorda regions there is no technological infrastructure, a poorly developed research base, and enterprises are specialized in low-tech industries, which hinders the development of knowledge-based industries in these regions. The same is observed in Akmola, Kostanai, Almaty and Zhambyl regions, which are characterized by a low level of development of the scientific base and underdevelopment of the manufacturing sector, therefore the development of knowledge-based sectors of the economy appears to be unoptimistic [30, 31].

The above discussed suggests the possibility that the development of knowledge-based sectors of economy of Kazakhstan will not be country-wide, but "focal" in nature, being distributed within individual high-tech territories or "high-tech districts".

It can be assumed that in Kazakhstan due to the accumulated level of development of high technologies sector, it makes sense to align with the second described model of non-districts development. Particularly, Astana Business Campus can develop as a high-tech district. These expectations are real, as the scientific park becomes the place of attraction for large transnational corporations, technological national companies, small innovative enterprises, etc. Notwithstanding, it should be kept in mind, that in the traditional industrial sector the main factor is the creation of productive capacity, then in relation to tech-intensive sectors only the development of research and innovation potential, even a large one, is indispensable. Major efforts and time are also required for the accumulation of human and institutional capital, and the formation of mechanisms for the exchange of knowledge.

The forthcoming of another technology-intensive business location is associated with the development of the Park of innovative technologies in the village of Alatau, Almaty region [32]. For now, it specializes in IT-technologies, but emergence of other knowledge-based entrepreneurship can be expected here, for example, in the field of nanotechnologies. It is not a coincidence that at a proper time the idea of creating a large joint Kazakh-Russian center in the field of nanotechnologies was studied in depth. Furthermore, the development of tech-intensive sectors in conjunction with the historically established trajectory based on an extensive network of educational and research organizations is possible. In this regard, especially favorable prerequisites have Almaty and Karaganda cities, which have long-standing scientific traditions.

Depending on the scale, "high-tech districts" can be of several types: science-intensive hubs, high-tech clusters, technopolises, and smart cities (Table 2).

The best prospects for the development in the form of knowledge-based hubs in Kazakhstan are in Nur-Sultan and Almaty cities. The main priority here could have been the development of digital economy sectors: Industry 4.0, e-government, banking and insurance, digital healthcare, media and entertainment, logistics, tourism & hospitality, retail. Due to this, the cities can be called "digital-hubs".

Tab. 2. Promising types of «high-tech districts» in Kazakhstan

Type	Localization	Structural element	Way of development	Case
Digital hub	Megapolis	Local knowledge base, universities and research institutes, small and medium-sized enterprises	Digitalization of the leading sectors of the economy, urban economy	Nur-Sultan, Almaty
Cluster (high- and medium-tech)	Dedicated area in a big city and suburbs	University, research institutes, technopark, small and medium enterprises	Innovation	Nazarbayev University, PIT Alatau
Technopolis	City territory	University, research institutes, small and medium-sized enterprises	Innovations, new construction	Potentially Talgar city, one of the cities of the 4G-City project
Smart city	Territory of a big city	Urban infrastructure	Separate smart projects with the prospect of merging into common digital platforms	Akkol, the city of the 4G-City project

Note - Compiled by the authors

The best prospects for the development in the form of knowledge-based hubs in Kazakhstan are in Nur-Sultan and Almaty cities. The main priority here could have been the development of digital economy sectors: Industry 4.0, e-government, banking and insurance, digital healthcare, media and entertainment, logistics, tourism & hospitality, retail. Due to this, the cities can be called "digital-hubs".

Digitalization of these cities requires the creation of various multidisciplinary partnerships, including universities, research institutes, companies, ICT providers, local business support structures. These partnerships create an ecosystem of knowledge-based entrepreneurship. One of the ways of high-tech districts develop in Kazakhstan can become their distribution in the territories, which did not have sustainable traditions earlier in the field of high technologies and in the territories of new development as well.

With this background to our view, Talgar city has a promising outlook, which is 25 km. away from the "southern capital". This city is located in an area with attractive natural and climatic conditions and belongs to a large urban, Almaty, agglomeration, characterized by a developed scientific potential and social infrastructure, which contributes to the development of advanced R&D areas and related science-intensive industries. In particular, this city must be given preference in providing a research and production complex in the field of electronics (semiconductors, optoelectronics, computer chips) in the republic. There is value in the opening here a higher educational institution of the same a similar profile giving it the direction of a technical university so that it becomes the core of the future scientific park. Enterprises for the production of efficient catalysts, and joint ventures for the assembly of household radio equipment, can be created here. From the perspective of the de-concentration of the Almaty agglomeration, the city of Talgar with the adjacent academic town in the village of Alatau hereinafter must be regarded as a zone for the transfer of research and educational potential from the capital of the republic, focusing on its development in the 21st century as a city of science ("technopolis").

"4G City", could have become a progressive point for accommodating knowledge-based sectors, which involves the construction of four structurally integrated smart cities between the cities of Almaty and Kapchagay by 2040. The project's main objective is the creation of new smart cities of Almaty agglomeration with comfortable facilities for intensive development of business and comfortable life for the population[3].

These cities initially are planned as smart cities. However, it must be pointed out that way is cost-based. Already at the first stage of the project implementation of only one city out of four, there were spent 31 billion tenge. Songdo Smart City (Songdo International Business District) project is Implemented in South Korea. The cost of the project is about 35 billion US dollars. Songdo Smart City Project is being implemented in South Korea. The cost of one project is around 35 billion USD[4]. Considering the given investment factor the acceptable direction of smart cities development in Kazakhstan can become the construction of the cities "from scratch", but development like the ones of existing small cities. For instance, in 2018, Kazakhstan launched the Akkol-Smart City project. The city is located 100 km from Astana. The area

[3] About the projetc «G4 City». G4; 2021 [updated 13 January2021; quoted 13 January2021]. Available at: http://www.g4city.kz/o_proekte?language=ru

[4] Songdo IBD. Songdo IBD; 2021 [updated 13 January2021; quoted 13 January2021]. Available at: http://songdoibd.com/about/

of the city is 9400 square kilometers, with a population of 13708 people. At present, a 3D map has been created in the city, communication sensors have been replaced, 4G has been installed, surveillance cameras, turnstiles, etc. have been installed

"Smart" development of such cities in Kazakhstan can be started from separate smart projects, and then proceed to the creation of a unique digital platform where all city facilities, government agencies, enterprises, and residents will be integrated and actively interact online.

Special Economic Zones as Growth Points for a Knowledge-Based Economy

One of the most eligible options for knowledge-based sectors of economy distribution for Kazakhstan is the development of knowledge-based clusters based on the special economic zones (SEZ) and technoparks. According to global practice, the most active points of knowledge-based economic growth stand out as special or free economic zones. Their number amount to about two thousand, and they have different geographical spread and industry specialization A special regime of economic management based on the optimal combination of various benefits is introduced (rental, customs, labor, visa, currency, etc.), which determine favorable conditions for investing in priority sectors which are most often announced as high-tech and resource-saving industries.

In Kazakhstan, already in the beginning of the 90-s, as known, there were created 10 special economic zones. Nevertheless, the first experience of SEZ creation in Kazakhstan was in vain and was abolished. From the beginning of 2010, the interest in SEZ again appeared and in 2011 there was adopted a corresponding law which there were created 10 SEZ they engaged 518 residents and created about 6,000 jobs [32, 33]. Today there are 13 SEZ[5]. The results of their activity are controversial. On the first part over the course of their existence over 50 billion tenge have been deducted in the form of taxes. In the second part, there are few real operating projects created in SEZ (23 in SEZ "Astana - New City", 9 in SEZ "Seaport Aktau", 8 in SEZ "Ontustik", 1 in SEZ "Khorgos - Eastern Gates"). Majority of SEZ are provided with infrastructure at a low level [34]. Particularly noteworthy is the fact that the purpose of SEZ is poorly implemented - to promote the creation of a new high-tech production.

A new stage of development of special economic zones in Kazakhstan requires changes in the territorial policy. First of all error check and omission of errors is required during the formation of the first zones. Territorial limitation of zones should be introduced. They must differ in their boundaries from regions. Companies registered in the zone must be entirely located on its territory, without other representative offices and branches. This is necessary to make it impossible to transfer financial flows to the SEZ territory, receive tax benefits, and carry out real activities outside of it.

For this purpose, it is necessary to aim at cluster generation in the territory of SEZ. However, currently, clustering in the activities of SEZ Kazakhstan is not observed, while there is defragmentation of technological chains. Thus, for their production, SEZ "Saryarka" and SEZ "Ontustik" import rolled metal and cotton products, respectively.

Nevertheless, SEZ Kazakhstan has the potential for the successful clustering of knowledge-intensive industries and services (Table 3).

If the SEZ regime is tested in many countries to the full, SEZ regime can result in the development of knowledge-based clusters of industry, which differ in the full cycle of production characterized by a full cycle of knowledge-based production, close ties between their science and high-tech business. Developing knowledge-based clusters is possible only when combining science and technological production.

In this respect, the SEZ formation policy must be directed at the development of knowledge-based production and knowledge-based service, which will help to create new sectors of the economy, increase the number of innovation-active enterprises, and increase the export of science-intensive and high-tech products, which eventually will drive up the competitiveness of domestic goods.

Knowledge-based clusters development based on technoparks

The development of knowledge-based technoparks in Kazakhstan can also be implemented based on technoparks. The primary type of activity of Kazakhstani technoparks is defined by the Entrepreneurial Code of the Republic of Kazakhstan as technological business incubation. However, created in the country two-level system technoparks (national, regional) did not become the driver of knowledge-based economy. Today technoparks of Kazakhstan often function as usual business incubators for local enterprises of traditional sectors, not implementing its primary objective- promotion of innovation activity of firms and support of knowledge-based entrepreneurship. From our point of view, proceeding from present-day conditions in the republic, there can be developed park formations, where the core is a research center: science parks focused on R&D and small-scale production of prototypes, and technology parks focused on large-scale production (Table 4).

[5] List of SEZ and IZ. Kazakh Invest; 2021 [updated 13 January2021; quoted 13 January2021]. Available at: https://invest.gov.kz/ru/doing-business-here/fez-and/the-list-of-sez-and/

Tab. 3. Developing and potential clusters of knowledge-intensive industries based on SEZs' territories

№	Cluster specialization	SEZ Territory
High technologies		
1	Tech Garden, ICT, emerging technologies (clean, smart and green technologies, media, E-commerce)	"Park of innovative technologies", "ICBC "Khorgos"
	Health care and pharmaceuticals, medical equipment, information technology (manufacture of computers and peripherals, computer services, software). Creative cluster	"Astana-technopolis", "Qyzyljar"
3	Alternative energy, production of electronic parts. Aircraft manufacturing. Manufacture of basic pharmaceutical products and preparations, medical equipment	"Astana - a new city"
4	High-tech services (smart city, congress and exhibition, tourism, financial, etc.)	"Astana - a new city", "Turkistan", "Park of innovative technologies"
Medium technologies		
5	Mechanical engineering	"Astana - a new city", "Saryarka", "Seaport Aktau", "Qyzyljar"
6	Chemistry	"Astana new city", "Taraz", "Pavlodar"
7	Metallurgy	"Saryarka", "Pavlodar", "Astana - a new city"

Note - Compiled by the authors on the basis of the Concept for the formation of promising national clusters of the Republic of Kazakhstan until 2020 and the website of JSC National Company "Kazakh Invest"

Tab. 4. Potential innovation clusters based on technoparks of Kazakhstan

Potential innovation cluster	Basic technopark	Priority direction of technologies	Location (city)	Region specialization	Subject Contributing to Cluster Formation
1	2	3	4	5	6
High-tech innovation cluster					
Nuclear and Radiation Technologies	Nuclear Technology Park "Tokamak"	Nuclear technologies	Kurchatov	Non-ferrous metallurgy, mechanical engineering, chemistry, electric power industry	Institute of Nuclear Physics, Kazatomprom, mining and manufacturing enterprises
Space technologies	Technopark of Space monitoring	Space technologies, radio electronics, communications, nanotechnologies, new materials	Priozersk (1), Almaty (2), Nur-Sultan (3)	Non-ferrous metallurgy, mechanical engineering, electric power industry, cultural, educational, scientific and financial center, mechanical engineering	Aerospace Committee, Space Research Institute, Kazkosmos, Baikonur Cosmodrome, Center for Astrophysical Research
Pharmaceutical / Biotechnology	"Regional Technopark of Astana" LLP	Pharmaceuticals, feed additives, purified enzymes for agricultural processing, crop protection and pest control	Nur-Sultan	Agricultural products, light industry, chemistry, pharmaceuticals	National Center for Biotechnology, "Astana Medical University", S. Seifullin Kazakh Agrotechnical University , "Shipa", "Almaty Pharmaceutical Factory", "Pavlodar Pharmaceutical Plant", enterprises of medical preparations of the Ministry of Agriculture of the Republic of Kazakhstan, SANTO (Polpharma Group)
	"Regional technopark in the South Kazakhstan region" LLP	Pharmaceuticals, agro-industrial complex, biotechnologies	Shymkent	Chemistry, agricultural production	

1	2	3	4	5	6
Medium-tech innovation cluster					
Special metallurgy. Special chemistry. New materials. Engineering.	"Technopark K.I. Satpaev" University	ICT, oil and gas sector, exploration, metallurgy, mechanical engineering	Almaty	Scientific and financial center	"Donskoy MPP", "Kazphosphate", Academy of Mineral Resources of the Republic of Kazakhstan, "Kazakhmys", "Kazzinc", UMP, "Ust-Kamenogorsk Titanium and Magnesium Combine", VNIITsvetmet, Eurasian Industrial Association "Mittal Steel Temirtau", Institute of Metallurgy and Enrichment Ministry of Education and Science of the Republic of Kazakhstan, D. A. Kunaev Mining Institute, Scientific Center of the Complex Processing of Mineral Raw Materials of the Republic of Kazakhstan, Chemical and Metallurgical Institute
	Technopark "Sary-Arka" LLP	MMC, new materials, mechanical engineering, chemistry	Karaganda	Non-ferrous and ferrous metallurgy, mechanical engineering, building materials	
	Technopark "Algorithm" LLP	Oil and gas sector (petrochemistry, mechanical engineering and metal processing), instrument making	Uralsk	Oil and gas production and gas processing industry, mechanical engineering, building materials	
	Technopark "Altai" LLP	Technologies and developments	Ust-Kamenogorsk	Non-ferrous metallurgy, mechanical engineering, chemistry, production of building materials	

Note - Compiled by the authors based on the Strategy for the Territorial Development of the Republic of Kazakhstan until 2015 and the source [35].

As table 4 shows, the development of a knowledge-based economy in the framework of clusters can go with specialization in medium-tech and high-tech types of production about the industry specialization of the regions of Kazakhstan.

Conclusion

During the research, the potential for the spatial development of knowledge-based sectors of the economy of Kazakhstan was studied. It showed that the development of knowledge-based sectors of the economy necessitates particular prerequisites and conditions, inherent in the territories to a different extent. This stipulates uneven character of spatial distribution of the knowledge-based economy. Such factors as market demand, developed market and institutional environment, high scientific, educational, and technological potential, and socio-cultural context have a particular influence. Analysis of such factors that exist in the regions of Kazakhstan allowed one to conclude the inevitable "focal" nature of the territorial distribution of knowledge-based activities.

At the stage of knowledge-based economic development sectors in Kazakhstan, it is reasonable to rely on the emergence of "high-tech districts", that is, the distribution of knowledge-based activity in limited territories. Depending on the scale, the "high-tech districts" can be of different types: knowledge-based hubs, knowledge-based clusters, technopolises and smart cities.

The most promising perspectives for development in knowledge-based hubs in Kazakhstan are the cities Nur-Sultan and Almaty. The main priority could be to develop digital economy sectors: Industries 4.0, e-government, banking and insurance, digital healthcare, media and entertainment, logistics, tourism and hospitality, and retail. Therefore, these cities can be called "digital-hubs".

The top priority option for the location of a knowledge-based economy for Kazakhstan is developing knowledge-based clusters in the framework of a free-economic zone and technoparks. One of the directions according to which high-tech districts must be developed in Kazakhstan must become their distribution in the territories that previously did not have stable traditions in the field of high technologies and territories of new development.

The progressive points for creating such high-tech districts can become the city of Talgar and the 4G City project, which involves the construction of four structurally integrated smart cities between the cities of Almaty and Kapchagay 2040. The proper direction of smart city development in Kazakhstan can become not the construction "from scratch", but the development of small cities as smart ones,

for example, gradual implementation of "smart city" projects.

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